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# Building A Home Freezer

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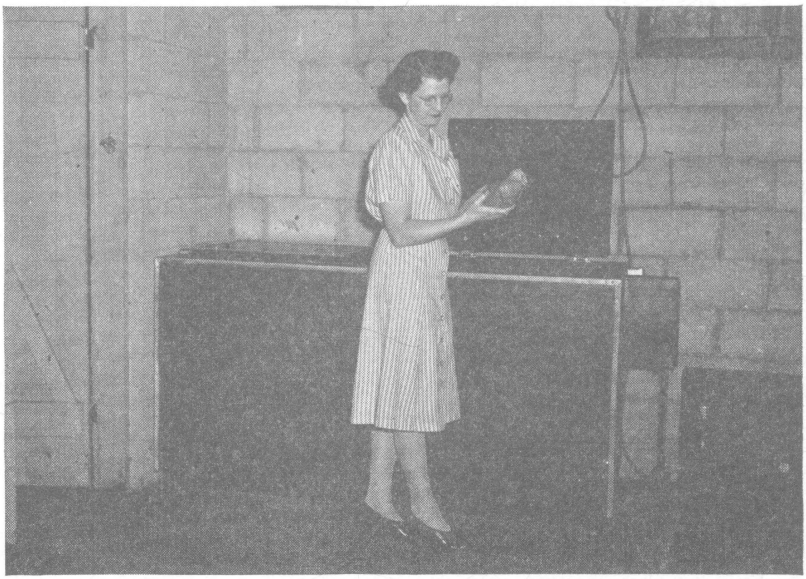

This home-built freezer has been in use seven years and the only repair has been one drive belt. It has a capacity of 15 cubic feet and is serving a family of four.

The acceptance of preservation of food by freezing is shown by the great increase in locker plants and in the manufacture and sale of home units. Even though home freezers are available in a wide range of sizes, there is considerable interest in homemade freezers and many requests have been received for plans and building instructions.*

The reasons most generally given for wanting to build a home freezer are: to save money; to meet special requirements as to location and use; to get better insulation; and to assemble the freezer where it is to be used.

* These plans and instructions for building a home freezer are based on a study sponsored by the Research and Development Laboratories of Owens Corning Fiberglas Corporation, through The Ohio State University Research Foundation.

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## *Size of Freezer*

The choice of a size of freezer to be built should be carefully considered. The size required will depend on the way the freezer is to be used and the number in the family. If the freezer is to be used in conjunction with a frozen food locker plant, it is necessary to have only enough capacity to freeze a limited quantity of fresh garden products and to store food for immediate use. For this purpose, a 4- to 8-cubic-foot cabinet should be sufficient for most families.

If the freezer is to be used to store the meat, fruits, vegetables, and other products of the family food supply, a larger capacity will be necessary. A minimum of 6 cubic feet per person is recommended. One cubic foot will store about 20 quarts of fruits or vegetables or 35 to 40 pounds of meat. Future development of frozen foods will increase the use of freezers and will tend to increase rather than decrease the required capacity.

If the freezer is to be used on a semi-commercial basis to market some of the farm products, or if large meat animals are to be processed on the farm during the warm part of the year, a cooling room, as well as larger freezing and storage space, will be required.

The following instructions and drawings are for a 25-cubic-foot capacity, chest-type, home freezer. A 25-cubic-foot capacity freezer will meet the minimum storage requirements for a family of four. If it seems desirable to make the freezer some other size, the dimensions can be changed to the required capacity. See table for dimensions. First, determine the dimensions of the storage compartment as given in the table and change the outer dimensions accordingly. The principles of construction will remain the same.

Refrigeration is the process of removing heat from a body or space and keeping that body or space cool or frozen once the heat has been removed. It is the refrigeration machinery—the condensing unit and the evaporator or cooling coils—that removes the heat from a home freezer. It is the cabinet that limits the amount of heat leaking into the freezer from the outside air. There is always some heat leaking into the cabinet through the insulation. This heat

*Sizes of Freezer-Locker Cabinets and Condensing Units and Evaporator Requirements for Each Refrigeration System*

| Cabinet Sizes | | Condensing Unit Size (H.P.) | Evaporator Plate Area (Sq. Ft.) | Number of 19" x 21" Cold Plates Required | ½" Copper Tubing* Required) (Feet) | Turns of ½" Copper Tubing Around Inside |
|---|---|---|---|---|---|---|
| Inside Dimensions W x H x L (Inches) | Capacity (Cu. Ft.) | | | | | |
| 22 x 22 x 120... | 33.5 | ⅓ | 47 | 9 | 250 | 10 |
| 22 x 22 x 108... | 30.0 | ⅓ | 43 | 8 | 220 | 10 |
| 22 x 22 x 96.... | 27.0 | ⅓ | 38 | 7 | 200 | 10 |
| 22 x 22 x 84.... | 23.5 | ⅓ | 35 | 6 | 180 | 10 |
| 22 x 22 x 72.... | 20.0 | ⅓ | 32 | 6 | 170 | 11 |
| 22 x 22 x 60.... | 17.0 | ¼ | 30 | 5 | 150 | 11 |
| 22 x 22 x 48.... | 13.5 | ¼ | 28 | 5 | 135 | 12 |

* ½" copper tubing may be used as an evaporator instead of the cold plates.

must be removed by the condensing unit. Automatic controls start the condensing unit when the cabinet temperature rises to an upper limit and stops the unit when the temperature is reduced to a lower limit.

Figure 1 shows the refrigeration system used in the 25-cubic-foot, chest-type unit being described. The compressor, operated by an electric motor, compresses the refrigerant gas as it comes from the cooling plates. The compressed gas is hot and at a high pressure. In the condenser, the gas is cooled and in the cooling process changes to a liquid and flows into a receiver tank which is a reservoir for the liquid refrigerant. The flow of the liquid from the receiver into the cooling plates is controlled by an expansion valve which regulates the rate of flow so as to secure the most efficient operation. The liquid changes into a gas in the plates and takes up heat from the plates and the surrounding air. The gas from the plates returns to the compressor and is again compressed, completing the refrigeration cycle.

The liquid and gas flow only while the compressor is running. A thermostatic motor control starts and stops the motor that operates the compressor. When the plate temperature rises above a certain set value, the thermostat closes the motor electric circuit and the motor starts. When enough heat is removed so the plate temperature falls below a set value, the thermostat opens the motor circuit and the motor stops. Thus, refrigeration is supplied only when it is needed. The heat exchanger brings the warm liquid in proximity to the returning gas, warming the gas some, so there is less possibility of liquid getting back to the compressor and damaging the valves. It also cools the liquid refrigerant, making it somewhat more efficient in removing heat from the plates after it passes through the expansion valve. The purpose of the drier-strainer is to take any foreign matter or water vapor out of the liquid refrigerant. Water in the

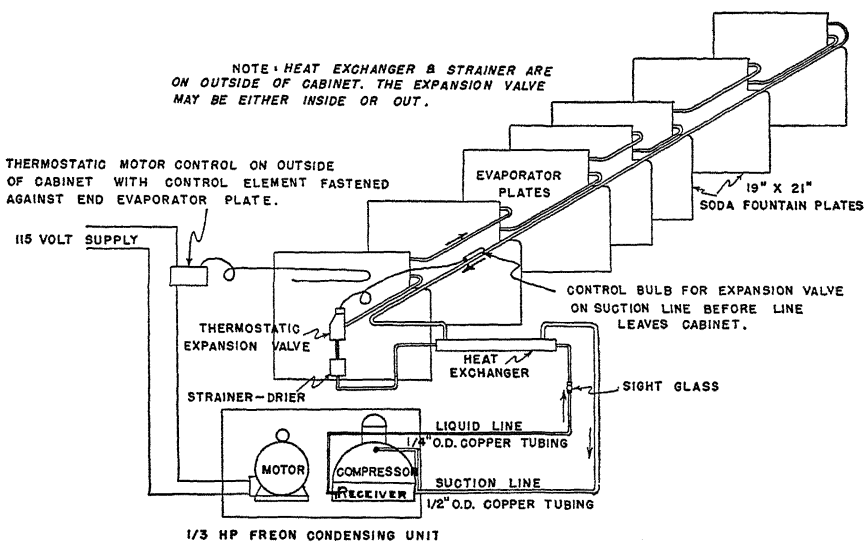


Fig. 1.—Refrigeration machinery used in this home freezer.

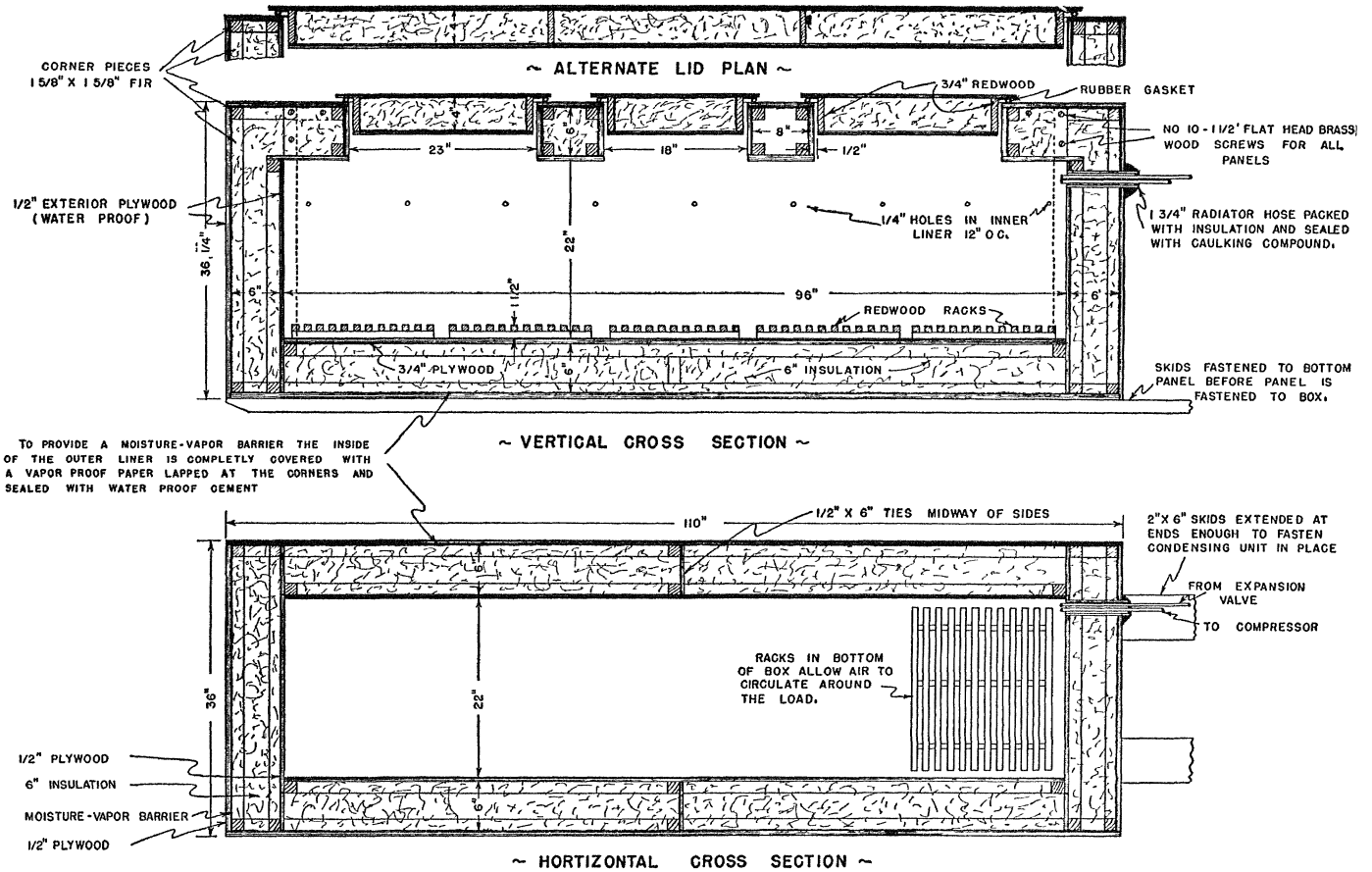


Fig. 2.—Alternate lid, vertical and horizontal cross section plans.

lines will cause the expansion valve to freeze, shutting off the flow of refrigerant. Foreign matter in the lines may damage the valve seats.

## *Materials of Construction*

The inside and outside liners of the cabinet must be of some material that is resistant to moisture and has the structural strength to withstand shocks and hard usage. *Exterior* type plywood has proven satisfactory for both the inner and outer liners. It is resistant to moisture. It is strong and is easily applied. Other materials, such as cement asbestos board, hard pressed fiberboard, shiplap covered with linoleum, or metal could be used. In any case, it must be kept in mind that the cabinet should be sturdy enough to last for years. The material used should not be affected by moisture, as both the inner and outer liners will be subjected to dampness at times.

For the corner framing, straight-grained fir has been used but any odorless, tough wood would be satisfactory. It is important that all materials be as free as possible from odor-forming properties. It has been found that some pines produce a bad odor. All the materials used in construction should be checked for odor-forming properties.

The door gasket can be a regular refrigerator door gasket, which can be

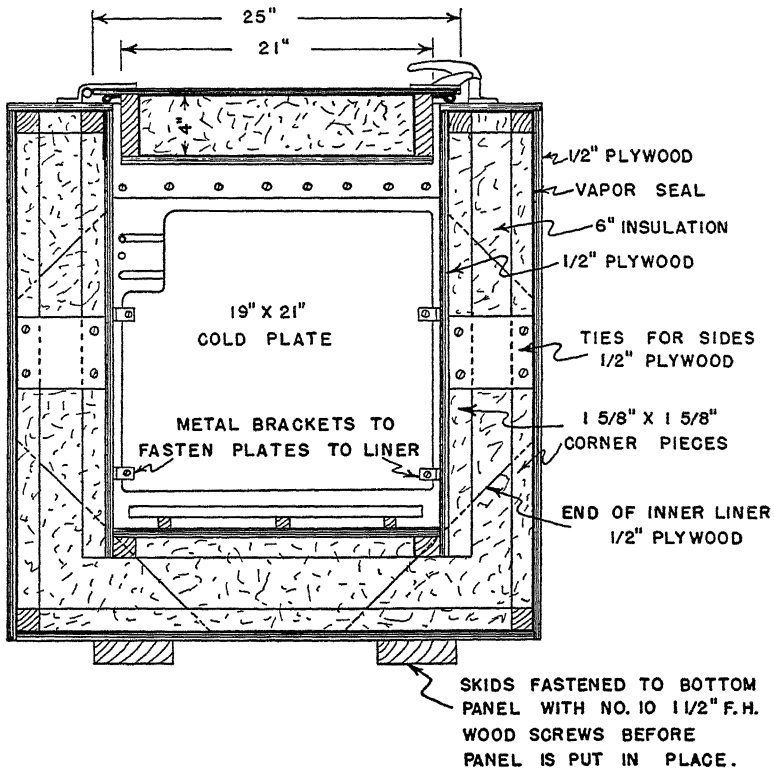


Fig. 3.—Cross section details.

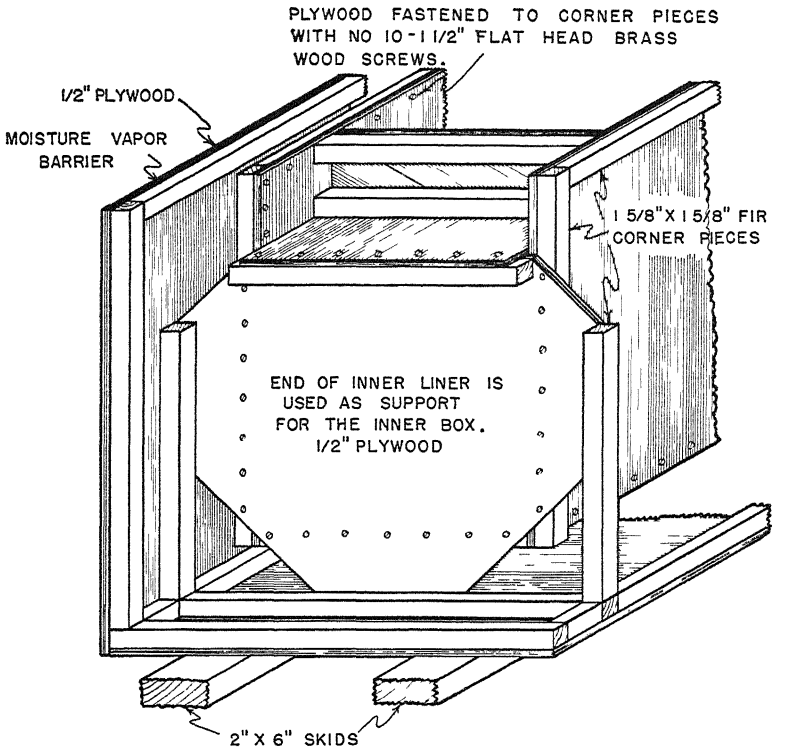

Fig 4 —End construction details

purchased in several sizes and shapes at refrigeration dealers. A good grade of sponge rubber may also be used. If sponge rubber is used, it should be rather soft and not have a tendency to get hard with age. The door latches and hinges should be non-corrosive and easy to clean. The plywood should be fastened to the corner pieces with brass screws. These will not corrode and mar the appearance of the box or become loose.

## *Insulation*

Briefly, the cabinet consists of an inner and outer liner with suitable insulation material between the liners and a vapor barrier to protect the insulation from moisture. It is necessary to select an insulation thickness that is economical and yet does not increase the outside dimensions of the cabinet so that it is difficult to put in and take out packages.

Tests show that 6 inches of insulation has a decided advantage in economy of operation over 4 inches of insulation. Eight inches of insulation did not show a similar advantage over 6 inches of insulation. The outside dimensions of a box with 8 inches of insulation make the box too large for convenience. The bottom of the storage compartments cannot be reached by a person of average height while standing on the floor. Six inches of good insulation seems to be the most desirable thickness. In large walk-in or front opening units, where

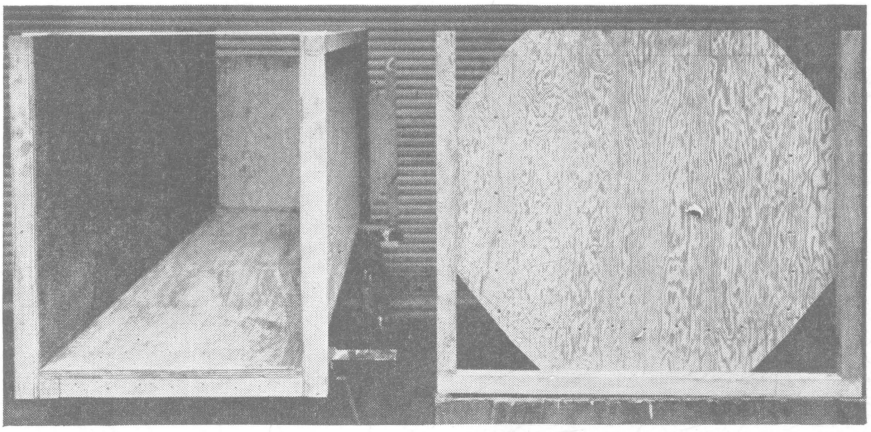

Fig. 5.—End and inside box support in place ready to install plates. The inside box was perforated with ¼-inch holes at about 1-foot intervals along the top and bottom to allow for escape of any moisture which might leak through moisture barrier.

the outside dimensions are not so important, it is probable that up to 8 inches of insulation can be economically used.

A good insulation material should, if possible, have the following properties:

1. Low thermal conductivity. For a home freezer, materials with conductivities above 0.30 Btu. per square foot per hour per degree per inch of thickness should not be considered, because thickness required would be prohibitive.
2. Stability. It should be stable both physically and chemically so that it will not deteriorate in a few years.
3. Strength. Strength is not extremely important in this type construction, but the material should be strong enough not to settle and leave an open space at the top.
4. Odor free.
5. Not harbor vermin.
6. Fire retardent.
7. Not support mold or bacteria growth.

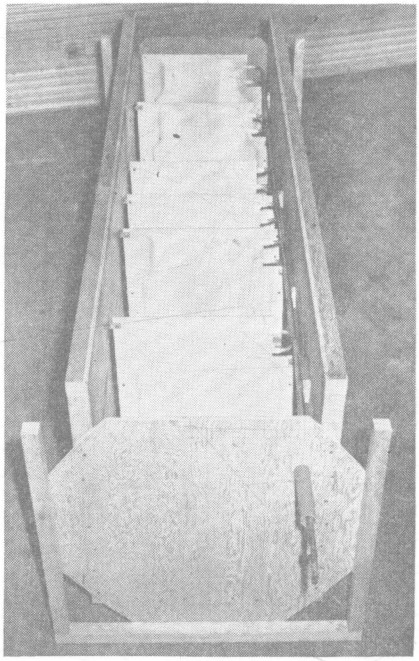

Fig. 6.—Plates and tubing in place ready for supports for lids. The tubes were run through 1¼-inch radiator hose where they go through the end of the box. The radiator hose was then packed with insulation, and the end sealed with caulking compound.

Any material that satisfies the above requirements should make a satisfactory insulation for the home freezer, if the cost is reasonable and it is available. Of the three types of insulation: board, blanket or bat, and fill, the blanket or

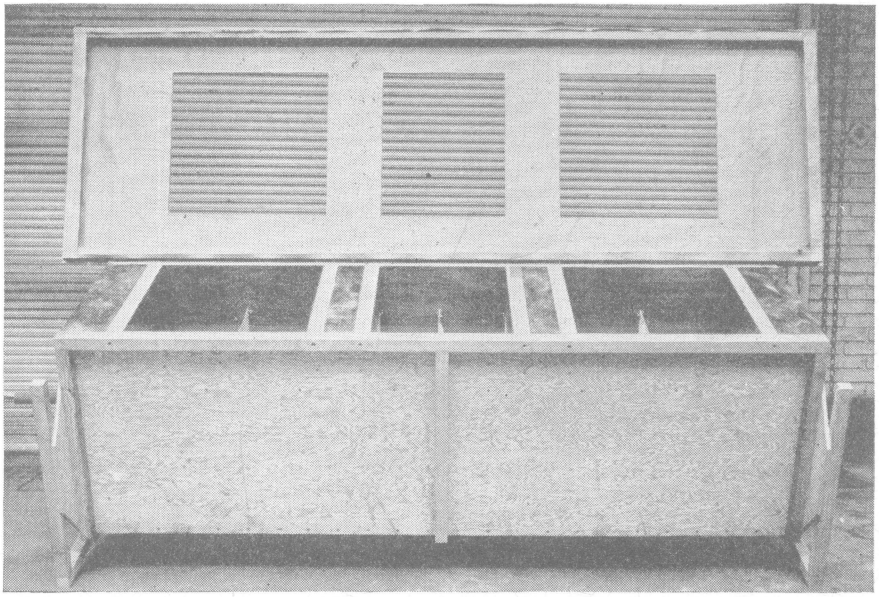

Fig. 7.—Supports in, ready for top piece of plywood to be fastened in place. All parts are of one piece construction.

bat forms are easier to use in the type of construction described here. The material is easily cut to size and placed in layers as will be explained later.

## *Vapor Barrier*

All air contains some moisture in the form of vapor. Due to the difference in vapor pressures of the warm air on the outside of the box and the cold air inside the box, this vapor tends to move toward the cold air. This movement of vapor would not be harmful except that at some point in the insulation it would cool enough to condense and form water or even ice within the insulating material. This would cause a breakdown in insulating properties.

To stop the movement of this water vapor, it is necessary to provide a vapor proof barrier around the outside of the insulating materials. *Never put a vapor barrier on the cold side of the insulation,* because if any vapor does get by the outside vapor barrier, it would then be trapped within the insulation. It is a better practice to provide vents in the inner liner so that if any moisture gets into the insulation it can move on into the box and be deposited on the plates as frost. In Figure 2, a row of ¼-inch holes is shown near the top of the inner liner.

There are two common types of vapor barriers in use. One is the paint type applied as a liquid and the other is the membrane type applied in sheets. As a general rule, the paint type is not satisfactory for this type of construction due to the difficulty of providing a continuous seal. Of the membrane type, the most common is a double ply asphalt bonded paper. There are others, such as metal

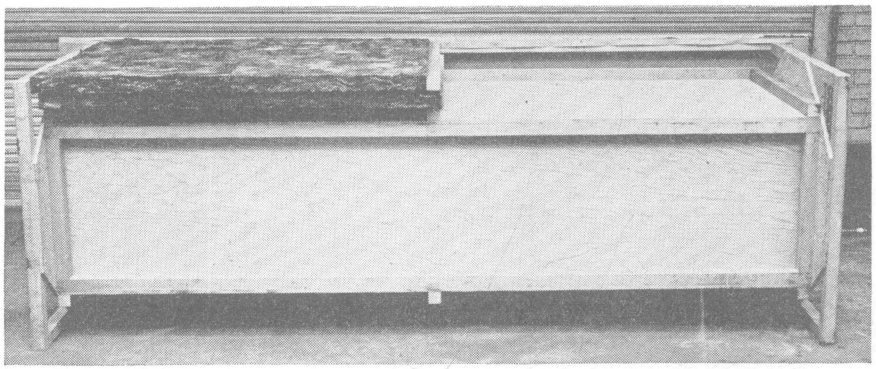

Fig. 8.—Starting to insulate side panels. Note vapor barrier paper lapping over top framing.

coated paper and metal foils but these are more expensive. Roll roofing and building papers usually are not vapor proof.

In applying the vapor barrier, care must be taken that a continuous seal is obtained all the way round. The paper must be lapped at the corners and cemented with a moisture proof cement and it must be sealed around all openings. Rubber weather-stripping cement is satisfactory. Apply a line of cement on both sides of the paper where the screws will pierce the paper and

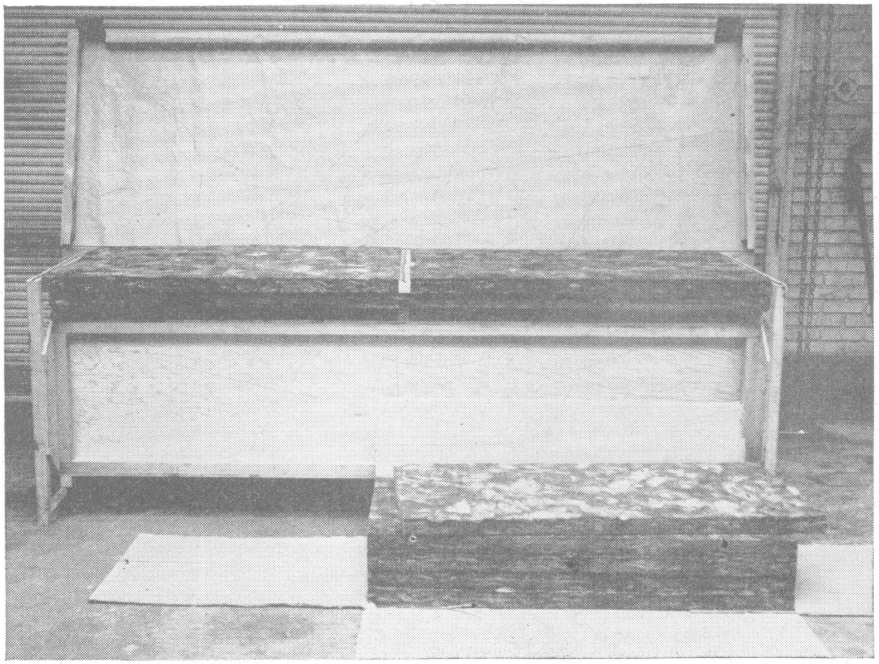

Fig. 9.—Insulation material in place ready for side to be put on. Vapor barrier paper against plywood of outside panel. Paper was put outside of the corner members and cemented along all edges. Opened box of insulation material in foreground.

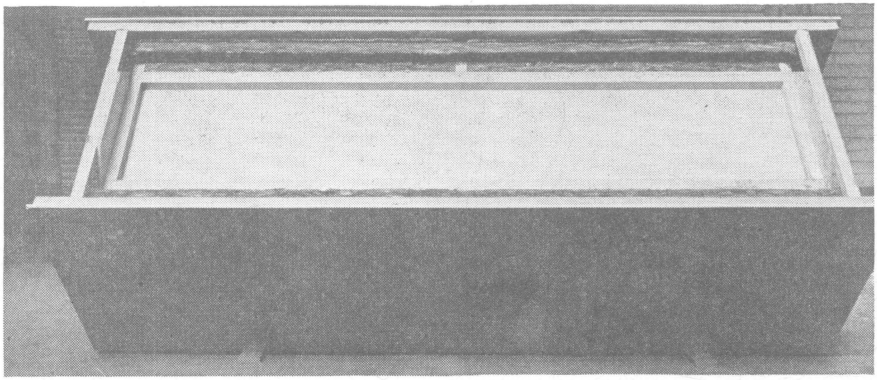

Fig. 10.—Both sides have been insulated and panels fastened in place ready to insulate the bottom.

where the paper is to be lapped. A grease gun with the spring and pump removed makes a good tool for applying the cement. *Make sure the seal is continuous.*

## *Construction*

Figures 5 to 15 inclusive, show a cabinet under construction. First, the inner liner is assembled and the cooling units and the connecting tubing are fastened in place. Then, the supports across the top are installed and insulated and the top panel screwed down. Make sure the vapor barrier is lapped and

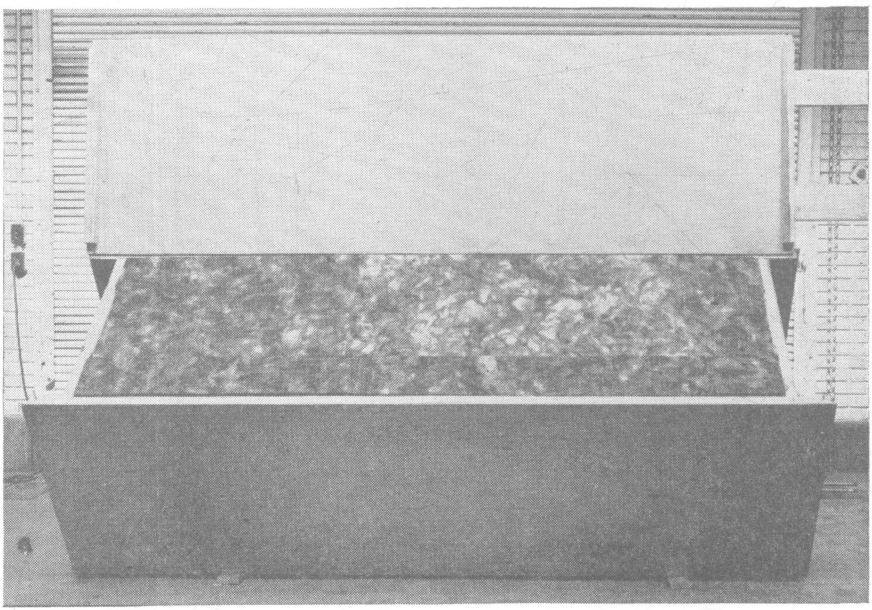

Fig. 11.—Bottom insulation in place ready for bottom panel. Two 2″ x 6″ skids are fastened to bottom panel before it is fastened in place.

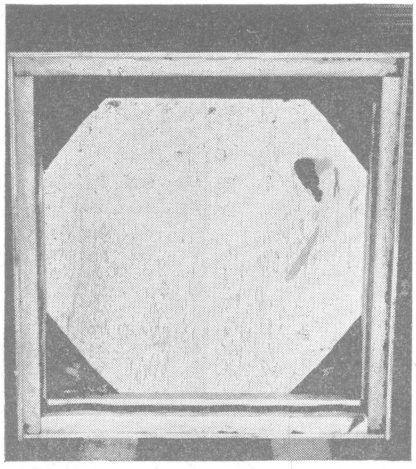

Fig. 12.—End, ready for insulation material.

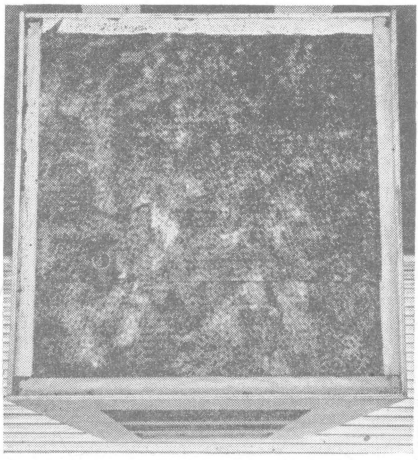

Fig. 13.—End with insulating material in place.

cemented at all corners. After the top is in place, the sides, bottom, and ends are finished in that order. The bottom panel of plywood is screwed to the skids before it is fastened in place on the box so that the screws do not penetrate the vapor barrier.

After installing the lids and the refrigeration machinery, the box can be finished on the inside and outside with a mixture of *pure,* boiled, linseed oil 40 percent and shellac 60 percent. The outside of the box should be covered with one or two coats of varnish. The lid gasket can be cemented to the lid with the same kind of cement used to seal the vapor barrier.

### *Refrigerating Machinery*

The condensing unit should be a low temperature unit of suitable capacity for the box being built. For the average home unit, the proper size of condensing unit can be selected from the table on page 2. If a second-hand or rebuilt unit is used, make sure it is adapted for low temperatures. A unit that has been used on a milk cooler or similar piece of equipment can usually be made to operate satisfactorily by speding up the compressor approximately 15 percent. This can be done by making the drive pulley on the motor about 15 percent larger.

The evaporator can either be plates,

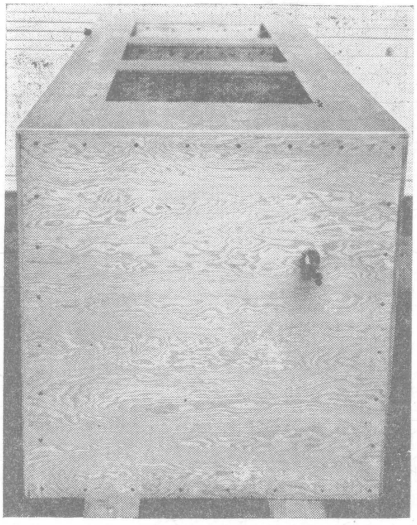

Fig. 14.—End panel fastened on.

as are shown in the drawing or can be made up of coils of copper tubing. The amount of plate area and length of ½-inch copper tubing are shown in the table on page 2. If the evaporator is made too small, the efficiency of the condensing unit will be reduced and the compressor will be overloaded.

The motor should be controlled with a temperature operated thermostat. The condensing unit may come equipped with a pressure operated control, but it is usually more desirable to use a temperature operated control. A temperature control with the control bulb located on a plate or coil will give the most satisfactory air temperature in the box. Set the temperature control so the inside temperature is zero and set the temperature differential on the control so the compressor operates three or four times an hour.

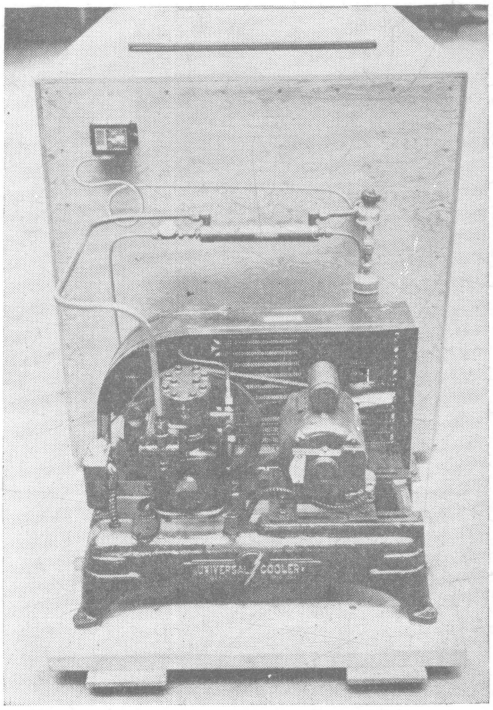


Fig. 15.—Condensing unit and controls at end of completed box.

The expansion valve should be a ½ ton, low temperature, thermostatically controlled expansion valve. The valve itself may be located inside the cabinet or immediately outside where the liquid line enters the cabinet. The control bulb of the valve should be on the return refrigerant line inside the cabinet. *Depend on your service man to install and adjust the refrigerant controls.*

## *Use*

The freezer can be used to freeze and store any food that is properly prepared and packaged. The maximum load that can be put in at any one time should not exceed that which can be completely frozen in 24 hours. Stack the package for freezing against a plate or coil and allow space for air to circulate about the other sides of the package.

## *Service*

All refrigerating machinery will require some service. Hermetically sealed condensing units will require less service, but must be removed and returned to the factory or service center, if any service is required. Open units require more attention and service, but can be repaired in place or taken to a refrigeration service shop.

Before starting to build a home unit, make sure all materials and services needed are available.